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The improvement and development during the past 10 to 15 years of biological and pharmaceutical agents as well as surgical equipment for use in the control of livestock and poultry diseases has been most interesting and valuable. During this period we have experienced also a global war. The mobilization of manpower, specialized training of personnel and production of equipment for their use, as well as the production of food stuffs, especially of animal origin, for our population and for that of many foreign countries, may have assisted in bringing about some of the rapid strides in the medical sciences. The progress by scientists was possible, mainly, because of an opportunity of free enterprise and individual initiative. The old proverbs, "Competition is the Life of Trade" and "Necessity is the Mother of Invention" still apply, and these too may have entered into the iniative resulting in the developments that we are to consider at this time.

The electro- and high-powered microscopes have been most useful in studying many disease processes of both humans and animals. In some instances these instruments have been responsible for identifying the causative agent of disease. The cultivation of disease-producing organisms, especially the lower forms such as viruses and rickettsiae, on the living chick embryo has contributed greatly in investigating numerous diseases. Likewise, the use of the chick embryo is of great value in the cultivation of viruses and rickettsiae for the production of effective prophylactic agents. Among these, the following are of significance in the veterinary field: equine encepholomyelitis, fowl pox, laryngotracheitis, Newcastle disease (pneumoencephalitis) of poultry and rinderpest of cattle. Rabies and canine distemper vaccines made in this way may be in the offing. Progress is made almost daily in the development of more effective vaccines for the control of foot and mouth disease which in recent years has been causing a great deal of excitement and concern because of outbreaks near the border of the United States. Cooperative effort among scientists from several countries are contributing toward this end.

Attenuating Organisms

Attenuation of organisms, especially viruses, by adapting them to other species, has modified them so that they will not produce disease in the natural host but when administered at the proper time will serve as effective antigens to stimulate resistance and immunity. This has been demonstrated by the adaptation of rinderpest virus to rabbits, virus of Carre to ferrets, and hog cholera virus to rabbits in experimental studies.

Irradiation of antigens by ultraviolet radiant energy is employed to inactivate organisms, including some of the elusive

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viruses so that they may be used safely for the vaccination of animals and man. This method is in use in the production of rabies vaccine and mink distemper vaccine. Irradiation is effective also for equine encephalitis virus vaccine.

The addition of new antibacterial and/or antiviral agents to antigens under certain circumstances for attenuation have provided several new biologic products; an example of this is hog cholera vaccine (Crystal Violet and Boynton Tissue Vaccine).

The preservation of bacterial and viral cultures by desiccation from the frozen state has been practiced for many years. This technique now is in wide usage to preserve vaccines from time of manufacture until used in the field. This insures more effective antigens for the prevention of disease. Examples of desiccated vaccines are *Brucella abortus* (Strain 19), *Erysipelothrix rhusiopathiae,* hog cholera, canine and mink distemper vaccines.

The development of new potency tests, and requirements that must be met before some of the biological products are released for use, have insured better and safer vaccines. An example of this is the Habel mouse potency test for rabies vaccine that has been required by the United States Bureau of Animal Industry since 1939 for all veterinary rabies vaccine.

Extensive attempts to obtain the antigenic fractions of organisms or mutants incapable of producing disease in susceptible animals currently are being pursued in some laboratories. These studies at the present time are still very preliminary; however, it would appear that progress is being made. One readily can visualize the great advantage of removing the nonessential portion of the organism and of using only the antigenic component in vaccinating animals. In a sense, this already has been done in the use of tetanus toxoid and staphylococcus toxoid.

In the field of chemotherapy there have also been great advances and these perhaps have been more dramatic than in the biological field. Two groups of agents commonly referred to as the sulfonamides and antibiotics generally are mentioned. It was about 1935 when we first heard of sulfonamides, the so called "wonder drugs." In 1949 approximately 1915 tons of these compounds were produced in this country. Sulfanilamide was the first of these compounds to be used. In rapid succession came other similar compounds, each having more favorable pharmacological characteristics, less toxicity, or possessing some particularly desirable antibacterial activity. Sulfapyridine was the second sulfonamide compound used clinically. However, it possesses inherent toxicity and although still dispensed for veterinary purposes is not widely used for humans. Sulfathiazole, the third sulfonamide compound to receive attention, has several unique characteristics. Its spectrum of antibacterial activity is indeed of interest to veterinarians; however, because of its rapid elimination from the body by the urinary tract, it is necessary to administer it frequently in order to maintain effective blood concentrations.

Sulfapyrimidine Compounds

The three commonly used sulfapyrimidine compounds, namely sulfadiazine, sulfamerazine, and sulfamethazine, possess characteristics that have made them the more ideal compounds for clinical usage. They possess a wide range of antibacterial activity and remain in the blood stream in safe and effective concentrations for relatively long periods of time. This is of importance from a veterinary standpoint because of the labor usually involved in administering drugs to animals. The intravenous, intraperitoneal and intramammary injection of the aqueous solutions of the sodium salts of sulfonamides has been most helpful in saving many animals that otherwise would have been lost or less profitable for the owner. The intravenous administration, especially of these solutions to critically-ill patients with bacterial infections is a great advance in the therapy of such cases. This is indeed a very

rational approach, especially for the initial treatment of ruminants where the effect of oral medication may be delayed because of the function of the compound stomach. The prompt response obtained following intravenous therapy is appreciated by many animal owners and, since it is a surgical procedure, it is not so readily attempted by the layman.

The intraperitoneal administration of sulfonamides has provided a fairly acceptable and effective method of treatment for some septicemic diseases of swine and of cattle that are difficult to handle otherwise. This, however, is not without certain risks, and care and caution should be used.

Other Sulfa Compounds

Thus far reference has been made only to the sulfonamides generally used for systemic effect. It should be pointed out that there is another group comprising sulfaguanidine, succinylsulfathiazole (sulfasuxidine), and phthalysulfathiazole (sulfathalidine) that are indicated for the control of enteric infections. Of these three sulfathalidine is of particular interest for veterinary use because of the very marked activity against coliform organisms and the fact that only a very low percentage of the oral dose of the compound is absorbed from the gastrointestinal tract. Solutions of these compounds can be made by the addittion of alkali to the water which will aid oral administration. This provides a fairly acceptable method for treatment of certain diseases of swine.

Sulfonamides, chiefly sulfaguanidine, sulfadiazine, sulfamerazine, sulfamethazine and sulfaquinoxaline, the most recent addition to the sulfonamides for veterinary usage, possess also antiprotozal properities and therefore are of value in the control of coccidiosis in poultry and other animals. Some of the compounds appear to have value therapeutically but generally are used prophylactically. Sulfaquinoxaline is effective in exceedingly low concentrations in feed and water. It is used continuously for long periods when the birds are most susceptible.

Antibiotics

The other group of compounds that has been responsible for dramatic results in chemotherapy are the so-called antibiotics. Of these tyrothricin was the first to be marketed and it was released initially for the treatment of bovine mastitis. It, like a more recent one, bacitracin, is limited to topical use either in solution or ointment form. Both agents are particularly effective against gram-positive organisms and unique in being relatively free from the criticism of causing the development of "fastness" or resistance by the organisms.

Penicillin was the second antibiotic to receive wide and very favorable reception. In 1949 the production of penicillin in this country was approximately 82.5 tons. This substance may be administered locally as well as parenterally by any route. It is particularly effective against many gram-positive organisms. Since the advent of repository dosage forms of this substance, many of the early criticisms have been overcome. Tremendous quantities of this substance are used by the medical professions. Penicillin now has a very definite place in the veterinarian's armamentarium. Its use in the treatment of bovine mastitis due to streptococci is history making and worth many thousands of dollars to the dairy industry.

Streptomycin, the third antibiotic to be of wide-spread interest, is used chiefly for the treatment of gram-negative infections. In 1949 the production of streptomycin in this country was approximately 86.3 tons. In the veterinary field the clinical use of this substance is limited chiefly to enteric and urinary tract infections of small animals, and bovine mastitis due to coliform organisms. In human medical practice it is used widely for the treatment of tuberculosis, influenzal meningitis, brucellosis, and tularemia. Resistance to the drug appears to be developed by many organisms quite readily if inadequate dosage is given. When given in excessive amounts

this substance is not without toxic manifestation in humans. However, such toxicity in the veterinary field has not been reported.

The utilization of penicillin and streptomycin for the preservation of bovine semen and viral cultures is successful.

Aureomycin is a rather recently recognized antibiotic substance that possesses a very wide spectrum of antibacterial, antirickettsial, and even antiviral activity. It is effective by oral and parenteral administration but should not be given orally to adult ruminants since it will depress rumen digestion. The most extensive claim for aureomycin that has been made in the veterinary field is for the treatment of bovine mastitis, due both to streptococci and staphylococci. The substance is used in small animal practice for the treatment of septicemic diseases; however, apparently it is not effective in canine and feline distemper and encephalitis. Both aureomycin and another relatively new substance, chloramphenicol, are effective in suppressing acute brucellosis in human patients. This is of interest to veterinarians since many members of the profession contract the disease because of the nature of their work and frequent exposure to it.

The aforementioned drugs are unique in respect to their specific action against disease producing organisms. The mechanisms by which they act are not understood. Sulfonamides apparently achieve their effect by interfering with the metabolism of the organism, thus checking multiplication; and then phagocytes in the blood overcome and remove them. Antibiotics are considered to be bactericidal; that is they destroy the organism. These facts may be worthy of consideration in treating certain infections and in interpreting the results that are obtained. The fact remains that the agents have fairly definite actions and because of their specific effects overcome infections more promptly and effectively than did the chemotherapeutic agents used in former years.

Trends in nutrition of animals including poultry, have been changed in recent years, since we have learned more about the basic nutritional requirements of our livestock The vitamin requirements, as well as those for protein, carbohydrates, fats and minerals have received detailed study. It would appear that the knowledge presently available with respect to animal nutrition is more widely used and perhaps better understood in the feeding of animals than in the feeding of man. The recent information with respect to vitamin B_{12} (animal protein factor) when used to the fullest extent, especially in preparing poultry and swine feeds undoubtedly will have a very favorable effect on the economy of animal production.

Hormonal Therapy

Hormonal therapy in the veterinary field certainly is only in its infancy and as we obtain more specific understanding for the use of these agents, especially the sex hormones, undoubtedly they will be used more effectively. The estrogens already have been demonstrated as very effective substances for restoring successful breeding in many animals.

The progress that has been made in the development and use of new and more effective parasiticides, both for internal and external parasites, has produced phenomenal results. It is said that phenothiazine alone is responsible for restoring the sheep industry in some parts of the United States. Sodium fluoride in proper dosage appears to be a very effective anthelmintic for ascariasis in swine. Certain arsenicals and piperazine compounds studies during the late war have been found to be of value in the treatment of filariasis in dogs and possibly other animals. Evidence that certain identified compounds have a lethal or degenerative effect on tapeworms has been presented.

The chlorinated hydrocarbons such as DDT, benzene hexachloride and chlordane are used widely to control effectively many of the external parasites and insects capable of reducing potential gains or production of animals as well as res-

ponsible for the spread of disease. The more extensive use of these and similar compounds undoubtedly will contribute greatly toward the economic production of food producing animals and pets.

In addition to the above, new knowledge in the management of our farm flocks and herds is useful in dealing more effectively with parasite problems.

Agents that have antisepitic and/or germicidal properties are used extensively in veterinary practice. To a long list of such preparations used for many years, we can add a relatively new type of substance generally referred to as a quaternary ammonium compound. Both cationic and nonionic agents are used. These compounds have excellent and desirable characteristics as detergents and thus are used to cleanse and prepare surgical fields or infected lesions. They also are used to cleanse and disinfect surgical instruments when other means of sterilization are not convenient or readily available. These agents frequently are used also for cleaning laboratory equipment, hospital wards, kennels and cages in which animals are maintained.

Anesthetic Agents

The development of new barbituric acid derivatives, both short and long-acting, and new local anesthetic agents have provided an opportunity for the surgeons to select and use safer and more effective anesthetic drugs. Combinations of several types of anesthetic agents frequently are employed. Present indications are that curare (the once considered potent poison) and curare-like agents will find a useful place in veterinary surgery.

Techniques for the administration of these agents also have been improved. Because of these facts, many surgical procedures now used by veterinarians are conducted in a more humane manner than were those of former years. Greater emphasis should be placed on the use of these anesthetic agents and techniques, since it is this phase of the veterinarian's work that in some instances is justifiably criticized.

Within the past fifteen to twenty years, the x-rays have been employed fairly extensively in establishing diagnosis in animals. The use of the x-ray as an aid has been most helpful to the veterinarian in determining the type and degree of injuries, especially in dogs, cats and horses.

X-ray therapy is used to a limited extent in the treatment of disease processes in some animals. This type of therapy undoubtedly is in its infancy, but already the value of it for certain conditions, especially the treatment of some neoplasms, has been well demonstrated.

Intramedullary Pinning

Fracture fixation, especially in dogs and cats, with metal pins applied either externally or through the intramedullary cavity, is today a popular approach in correcting this type of injury. This is indeed a new type of therapy in both human and veterinary fields.

In summary we could state that in recent years profound changes have been made in the control and management of animal diseases.

It is believed the continuation of scientific research will undoubtedly result in even a better understanding of our disease problems and methods for dealing successfully with them so that in the future more and better veterinary service may be rendered to the livestock industry.

Water suspensions of wettable 50 per cent benzene hexachloride powder are destructive to sheep scab mites in concentrations as low as 0.033 per cent of the gamma isomer.

Sulfaquinoxiline can be used prophylactically in coccidiosis in chickens, ¼ lb. per ton of feed being the recommended dosage.

Mares with fistulous withers or poll evil are invariably sterile.